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TOPICS: **1. RADIOS – RF SOFTWARE** **2. ELECTROMAGNETICS – RF-FRONT ENDS**

TITLE: **FREQUENCY SELECTIVE IQ PHASE AND IQ AMPLITUDE IMBALANCE ADJUSTMENTS FOR DIRECT CONVERSION OFDM TRANSMITTERS**

Direct conversion transmitters offer a cheap architectural solution for mobile systems, e.g. IEEE802.11a WLAN. But the disadvantages IQ phase and IQ amplitude imbalance imperfections have to be taken into account. Having additionally cheap, imperfect analog filters installed that introduce significant group delay and amplitude ripple the above-mentioned IQ imperfections start to change their behavior depending on the signal's frequency. This requires adaptive frequency selective IQ phase and IQ amplitude adjustments that will keep the overall system costs low but will provide simultaneously high RF signal performance results.
Hence this paper will concentrate on the mathematics and the implementation of a fully digital software + hardware based approach for high performance signal adjustments of frequency selective IQ phase and IQ amplitude imbalances in an OFDM transmitter. The transmitter setup is presented in figure 1). It shows a direct conversion OFDM transmitter architecture whereas after the IFFT a digital adaptive filter + IQ amplitude imbalance pre-equalizer and a digital adaptive IQ phase pre-equalizer has been inserted.

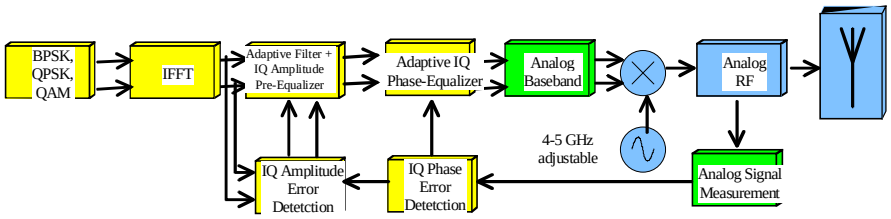

Figure 1) IEEE802.11a direct conversion transmitter with frequency selective IQ amplitude and IQ phase imbalance adjustment.

The adaptive IQ amplitude + filter pre-equalizer pre-equalizes the ideal digital data stream to remove the IQ amplitude imbalance and additional analog filter inaccuracies. The convolution of the digital pre-equalized signal stream with the analog filters removes the IQ amplitude imbalance imperfections.
Additionally the analog IQ modulator will insert an IQ phase imbalance error. This error will be removed by the very robust digital frequency selective IQ phase pre-equalizer. The digital IQ phase pre-equalizer is placed behind the digital filter pre-equalizer. Figure 2) presents an imperfect transmitter output, figure 3) and 4) describe the difference between conventional and the here proposed frequency selective adjustment algorithms.

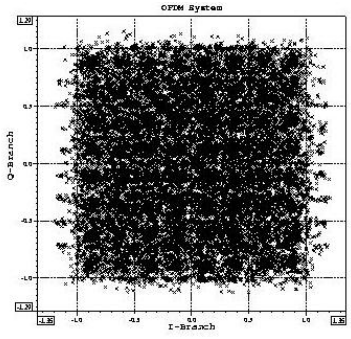

Figure 2) Non-ideal analog filters with up to 7dB amplitude ripple.

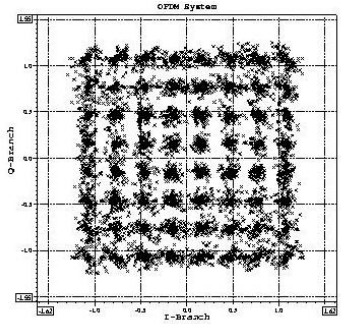

Figure 3) Conventional non-frequency selective IQ phase error adjustment.

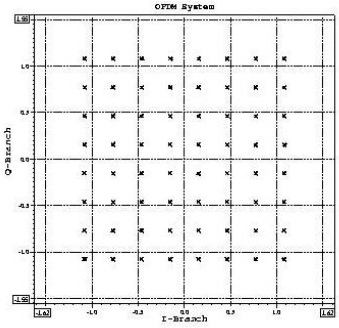

Figure 4) New frequency selective error adjustment.

Figure 3) provides the adjusted results using the new 19-tap amplitude + filter pre-equalizer and a conventional non-frequency selective IQ phase adjustment loop. Figure 4) uses again a 19-tap amplitude + filter pre-equalizer and additionally a 19-tap IQ phase imbalance pre-equalizer. Using the combination of both proposed algorithms leads to a fully digital software + hardware based solution to fulfill the IEEE802.11a high signal performance requirements for a low cost direct conversion OFDM transmitter architecture. For both algorithms the rare used error detection could be implemented via software, the continuously working error corrections via digital hardware.
References: 1. Comparison between Different Adaptive Pre-Equalization Approaches for Wireless LAN, IEEE PIMRC 2002, E.Coersmeier, E.Zielinski. 2. Frequency Selective IQ Phase Imbalance Adjustment for OFDM Receivers, IEEE ISCE 2002, E. Coersmeier.